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**IMPLEMENTING TOTAL QUALITY  
MANAGEMENT (TQM) IV:  
TECHNICAL GUIDE**

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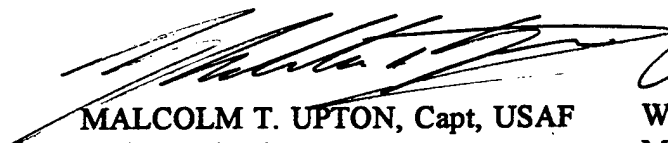
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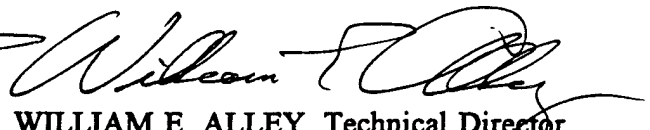
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## PREFACE

TQM/MGEEM is a significant breakthrough in productivity measurement providing a powerful set of new tools for improved management and a means of periodically soliciting worker input to identify barriers to performance. Chances for the success of any organizational development effort are increased when knowledge about its effects are more complete and apparent to those involved. The purpose of this special report is to provide organizations with general information on a variety of topics relating to TQM/MGEEM. This work is part of the Armstrong Laboratory's program to provide tools and technologies to measure and enhance organizational quality.

The authors thank Mr. Larry T. Looper for his unstinting support as a supervisor and his invaluable ombudsmanship. We would also like to thank the scores of people at conferences, presentations, and test sites that have provided us with valuable insight and feedback that has allowed for the continual improvement of both TQM/MGEEM and our presentation of it.

## SUMMARY

As the fourth in a series of special reports addressing the Methodology for Generating Efficiency and Effectiveness Measures (TQM/MGEEM), this guide serves as a reference covering a number of topics not addressed in detail in the other three TQM/MGEEM reports.

The first section of this guide discusses a systems model of productivity and performance called the Input-Output model. The general concepts and definitions are discussed and the model is related to performance and the need for measurement. Some of the characteristics of an ideal measurement system are discussed as these concepts may be applied to Air Force organizations. The second section addresses the importance of the mission statement to an organization and ties this into the teachings of the TQM masters. The third section of the report describes the Nominal Group Technique (NGT) as used in the TQM/MGEEM process including two different voting procedures and when to use each one. The final section addresses the question of how TQM/MGEEM is used to implement TQM philosophy. An overview of TQM/MGEEM is given with each of the phases of a TQM/MGEEM implementation discussed. The measurement system, including the Mission Effectiveness (ME) Charts, their benefits and uses, feedback to various organizational levels and the tie-in of teams in the TQM/MGEEM effort are presented. A discussion of each of Deming's 14 points and how they can be fulfilled by a TQM/MGEEM implementation is included and a discussion of potential pitfalls to be avoided follows.

Two appendixes are included: one that provides examples of TQM/MGEEM mission statements, KRAs, indicators and ME charts, and another that is a topically arranged, annotated bibliography of selected TQM materials.

## Implementing Total Quality Management (TQM) IV: Technical Guide

### Introduction

This guide is the fourth in a series of special reports dealing with the subject of Total Quality Management (TQM) and the Methodology for Generating Efficiency and Effectiveness Measures (TQM/MGEEM). This report was written to provide technical details and examples to supplement the information found in the previous three guides.

The first report in this series, subtitled "The Command Imperative," addresses the role of top management in implementing TQM in their organization (Weaver & Upton 1992a). The second report in this series, subtitled "A Facilitator's Guide," provides a step-by-step guide for facilitators to use in building a TQM/MGEEM measurement system (Weaver & Upton 1992b). The third report in this series, subtitled "Feedback and Continuous Improvement," provides information on the use of TQM/MGEEM as a vehicle for gathering and disseminating feedback and for continuous improvement of processes (Weaver & Upton 1992c). TQM/MGEEM is also documented in book form (Weaver, 1991).

### Productivity And Performance -- A Systems Model

#### Introduction

Understanding productivity in Air Force organizations is facilitated by envisioning organizations as systems. This section discusses system (or input-output) concepts that are basic to the understanding of productivity and to the use of TQM/MGEEM.

#### Basic System (Input-Output) Model

General Concepts. A system is a set of interrelated parts that have a common purpose or goal. An Air Force organizational system could be a wing or a squadron or even a work center within a squadron. Systems can be small or large; however, they all have a set of interrelated parts that share a common mission. For example, people, material, and equipment are interrelated parts of any system. Systems can be defined by their inputs, outputs, goals, and interactions with their environment across system boundaries.

Inputs. Inputs are resources which are managed to help a system achieve its mission. As a general rule, inputs can be classified into four main categories: Labor, Materials, Capital, and Energy.



**Outputs.** A second major system concept is that of outputs. An output is a product or service which a system produces to achieve its purpose. Outputs could be numbers of products produced, personnel trained or reports submitted to headquarters. Whatever the organization produces for use outside its own organizational boundaries is its output. A distinction is frequently made between intermediate outputs and final outputs. Intermediate outputs are those which are consumed by the organization itself (internal customers) or are necessary to produce final outputs. Final outputs are those that the organization exports across its boundaries to other organizational systems (external customers).

**System Boundary.** The boundary of a system differentiates it from its environment.

**Environment.** Once a system is defined by specifying its boundaries, the environment has also been defined. Anything that is not part of a system is part of its environment.

**System Diagram.** These basic system concepts may be depicted in a systems diagram (Fig. 1). As Figure 1 shows, a system is defined by its boundary, which separates it from its environment. In an open system, such as an organizational system, inputs are derived from the environment (suppliers). The system engages in value adding activities that use those inputs to produce outputs which are exchanged with the environment (customers). In most organizational systems, the flow of inputs is dependent on the extent to which the system outputs conform to the requirements of the environment. For example, system outputs can be defined by customer expectations of quantity, quality and price. A valuable insight to the traditional ideas of the system model is offered by Dr. J.M. Juran. His idea of TRIPROL, the triple role of an organization, states that any organization at different times takes on one of three roles, including those of both customer and supplier, to other organizations or individuals (Juran, 1989. Fig. 2).

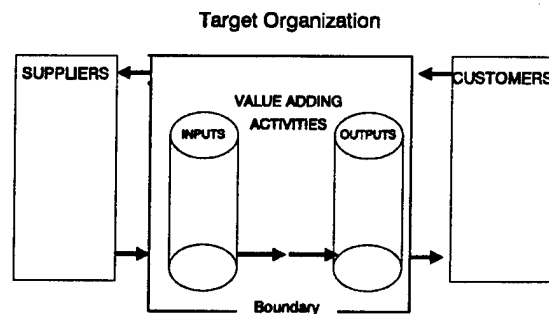


Figure 1. Systems Diagram.

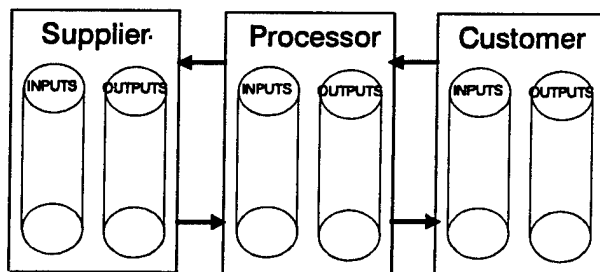


Figure 2. TRIPROL

## Performance and Measurement

How the Systems Model relates to performance. Now that the basic parts of an organizational system have been introduced, performance can be defined. As applied to Air Force organizations, performance has two elements: efficiency and effectiveness. Efficiency is concerned with the quantity of inputs required to produce a given level of outputs. Effectiveness refers to the extent to which the outputs conform to mission or customer requirements. Put another way, performance is concerned with both doing work right (efficiency) and doing the right work (effectiveness).

Measurement is Not an End in Itself. Performance measurement should be viewed as a tool for improvement. From a commander's perspective, the main reason to be interested in performance measurement should be to make performance better not just for the sake of measurement itself and certainly not as a tool for micro-management. When desire for improvement drives measurement, the chances for cooperation are increased, the duration of improvement is long-term and improvement potential is unlimited. Measurement should be viewed as the first step in the never ending management effort to enhance organizational performance.

What You Measure is What You Get. Measurement of an organization's performance sends signals throughout the organization as to what the commander views as important. Because of this impact of measurement, one must be certain to measure the right aspects of work. Resources, time, and materials tend to flow from unmeasured to measured aspects of organization performance. For this reason, one needs to be sure that a productivity measurement system adequately covers the key facets of an organization's mission.

Measurement Systems Fail If They Lack Acceptance. In order for a measurement system to be a performance enhancement tool, it must be understood and accepted by its users -- all the members of the organization. If not, users will find ways to avoid, fake, or otherwise defeat the system. Many elegant measurement systems imposed by headquarters have failed because they did not gain acceptance by those being measured. Experience shows that a successful way to increase understanding and acceptance by the users of a measurement system is to involve them in its development.

Measurement is a Substitute for Direct Observation. When measurement for continual improvement is the goal, measurement can often serve as a substitute for direct observation. An axiom that has guided military commanders through the years is to make sure that the critical aspects of performance are being carried out through inspection. In most organizations of any size it is impossible for the commander to inspect personally all aspects of performance. Therefore, measurement can become a substitute for

direct observation. Of course, no one familiar with TQM advocates increasing performance by relying on mass inspection. Some inspection is necessary, of course, but the focus of managers should be on continually improving the processes which produce the outputs being inspected. Emphasis in TQM is on improving performance by improving processes. In Air Force organizations where products or services are intangible, successful measurement allows the efforts of organization members to be made concrete and visible. Greater sophistication in measurement also makes process improvement feasible even in service organizations primarily engaged in the production of knowledge. Measurement should also serve as the basis of feedback to allow members to know how well they are doing. This is a powerful aspect of enhanced motivation.

#### Users of Measurement Data Must Understand Its Limitations.

Performance measurement is seldom perfect. It is subject to fluctuations sometimes beyond the control of the measuring organization. Furthermore, despite considerable effort, it is not always possible to measure all aspects of performance. In fact, Dr. Deming (1986) asserts that the most important figures are unknown and not knowable. This means that managers can only concentrate on improving processes. Furthermore, available performance measurement data must be interpreted with judgment. For example, when the number of hours required to repair a jet engine increases for a reporting period by 20%, this will be understood by a unit commander who knows that five new enlisted mechanics, just out of technical training, joined the unit during this period. However, someone up the chain of command who notices this drop in efficiency might attribute it to other causes and consequently take inappropriate and unwarranted action.

Most Organizations' Performance Can Be Measured. Given time and resources, almost anything can be measured well enough to provide a basis for improvement. After all, improvement is really the ultimate goal and measurement should serve that purpose. However, the feasibility of measurement may be a different issue. Not all aspects of performance that can be measured are worth the cost. Determination of measurement feasibility is a judgment of the commander. However, it is often difficult to determine the value of a particular measurement indicator until it is tracked over time. Therefore, managers are cautioned to reserve judgment about the feasibility of indicators until sufficient data exist upon which to make a valid judgment.

#### Characteristics of an Ideal Measurement System

Covers Important Facets of the Mission. The ideal measurement system should include indicators which encompass the most important facets of an organization's mission. Measuring only a single aspect of the mission can distort resource allocation decisions and

lead the organization to emphasize one aspect of its mission at the expense of other facets. For example, an organization may mistakenly emphasize quantity of output over customer satisfaction or readiness.

Should be Understandable. Bearing in mind that the most important measures are unknown and not knowable, measurement indicators and reports produced for commanders and members of the organization must be reasonably comprehensible. For measurement information to have value in guiding performance, users must understand how their performance is reflected in the numbers being tracked.

Should Usually be Controllable. Indicators which make up a measurement system usually should be under the control of the organization being measured. This does not mean that the measured organization can make the numbers say what they want them to say. It means that if the organization itself does a better or worse job, the numbers should change accordingly. There should be a clear relationship between the performance of the organization and changes in the indicators. Thus, indicators should be controllable as much as possible by organization members through their performance. An exception to this is when an organization's mission is significantly impacted by a process not completely under their control. When this is the case and the organization is building its relationship with the supplier or customer involved, a measure of the process in question may be useful, even if it is not completely under either party's control.

Includes Indicators of Efficiency as Well as Effectiveness. A balanced set of indicators include measures of the two facets of quality, quality of product/service (effectiveness) and quality of execution (efficiency). Measures such as on-time take offs or percent of people trained are examples of effectiveness indicators. Our experience is that efficiency indicators tend to be shunned and feared in the military. This is unfortunate because they are just as important to a quality organization as effectiveness indicators. Efficiency indicators are defined as an output divided by an input. Examples could be number of hits divided by number of bombs dropped or number of people moved divided by amount of fuel used in a month.

Experience with TQM/MGEEM suggests a tendency for Air Force units to focus more on effectiveness than on efficiency. This tendency should be counterbalanced by identifying the need to track resources consumed in relation to outputs produced (efficiency) along with how well the mission is being accomplished (effectiveness). The reason for this is that resources will always be limited. Whether in a draw-down, build-up, or full scale war the resources available to a commander are finite. If all of the resources are consumed in order to accomplish only a part of the mission, then mission effectiveness is sure to suffer. Even if

there are enough resources to meet the entire mission, increases in efficiency will allow more depth and scope in an organizations' mission as well as decreasing the strain on both personnel and machinery.

Indicators Should Vary. It does little good to track performance indicators that never change. For example, an organization could track safety by monitoring the number of fatalities. However, fatalities are rare events, fortunately, and, therefore, make poor indicators. A more useful indicator would be number of critical incidents or "near misses," since these may occur more frequently.

Indicators Should be Useful. Indicators used by an organization should reflect activities the commander and members of the organization wish to track in the interest of improving performance. However, because costs are associated with measurement, an organization should track only those aspects of performance for which the value of the information justifies its cost.

### Performance in Air Force Organizations

Performance and Readiness. One commonly held notion among Air Force commanders is that improving performance implies achieving peacetime resource savings at the expense of wartime readiness. This issue is addressed in AFR 25-2, Chapt 29, which notes that performance enhancement focuses on functions that are essentially the same in peacetime and wartime. For example, the Air Force launches and recovers aircraft, repairs equipment, delivers fuel, and procures and distributes supplies during both peace and war.

Wing commanders involved in a field test of TQM/MGEEM observed that in the Air Force, resource constraints are a way of life, whether in peacetime or wartime (Tuttle, Wilkinson, & Matthews, 1985). Therefore, commanders at all levels must be concerned with efficiency as well as effectiveness. In discussing performance and readiness, however, the issue is not one of tradeoffs between the two. The issue is assuring the maximum level of readiness for a given level of resources. Stated in this manner, improved performance is clearly consistent with improved levels of readiness.

Performance and Morale. There is often a tendency to think that performance improvement is obtained at the expense of morale. Experience suggests that while this tradeoff occasionally occurs, it is much more frequently the case that organizations which perform well also have high morale. High performance and high morale are complementary, not competing, aspects of organizational life. Indeed, it is at the heart of the TQM philosophy that performance barriers prevent workers from experiencing satisfaction in their work. Removing these barriers permits workers to

experience a greater sense of achievement and self-fulfillment. The key to this linkage lies in the following assumptions about people in organizations:

1. Most people want to do a good job.
2. Most people want to feel that they are a part of an organization that is worthwhile and is accomplishing something.
3. Most people need security, self-esteem, social acceptance, and recognition. People try to satisfy these needs, in part, through their work lives.
4. There is an overlapping relationship between organizational and individual goals.
5. Leadership and management provide the linkage between the satisfaction of individual and organizational goals.

Thus, a well-managed organization pays attention to the needs of both the individual and the organization. Such organizations generally have high performance and high morale. Organizations that are geared only toward the "non-personnel" goals of the organization usually only achieve high performance for the short term, and morale will invariably be low.

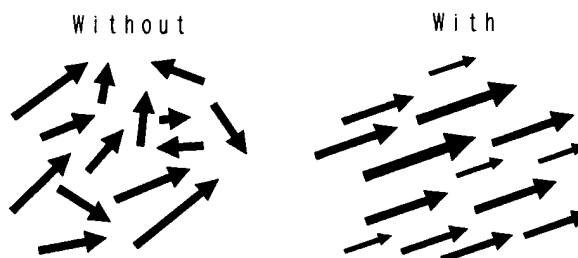
### The Importance of The Mission Statement

The mission statement is the embodiment of the aims of the organization. Those aims should be the foundation upon which all activities and decisions of the organization rest. A good mission statement helps organizational members decide the priorities of tasks and assignments, who their primary customers are, how work is to be assigned and the roles of leadership and workers. In a quality organization it is the touchstone for every decision that is made. Gitlow & Gitlow (1987) address the mission statement in great depth in chapter one of their book and Dr Deming's first point stresses the importance of mission and the need for leadership to constantly demonstrate devotion to that mission (Deming, 1986).

### Benefits of the Mission Statement

In addition to being a yardstick for decision making, the mission statement serves several other valuable functions. Since the statement is an accurate reflection of the mission of the organization, it can be a valuable aid to new members, both workers and leaders, in explaining the function and culture of the organization to them. It can also serve as a reminder and reinforcer of the organization's culture for current members, thus helping to bring everyone into a better working accord since they

can work toward common objectives. To illustrate, with a mission statement and leadership commitment to it, all the organizations arrows (members) can work in the same direction, instead of being chaotic and confused (Fig. 3).



From the idea expressed in Figure 3. With and Without a Mission Statement.

benefits of having a mission statement: constancy of purpose (despite change in leaders) and unification of the work force. The mission statement provides constancy of purpose despite change in leaders by socializing new leadership that may come into the organization. Usually the first part of a new commander or manager's tenure is often spent seeking to fully understand the organization's mission, and then the remainder of their tour is spent acting on their (occasionally incomplete) understanding of that mission. With a good mission statement, explicitly listed Key Result Areas and rational indicators, the chances of a new commander or manager misunderstanding the mission of the organization is greatly reduced. TQM/MGEEM provides new commanders with a good mission statement, the key measurable parts of the mission, and indicators designed to help measure and improve the key processes that lead to fulfilling that mission. Constancy of purpose as commanders change is thus greatly facilitated.

The second benefit that grows from the concept behind Figure 3 is unification of the work force. A good mission statement is written and can be explained in such a way that each person in the organization can see how their job fits into the mission of their work center, how their work center fits into the mission of its parent organization, and on up the line. Each member sees their work in the statement. The statement should also provide a rallying point unifying everyone toward the common goals of the mission. The mission should also be something that everyone can take pride in--something they are eager to show off by saying, "This is who we are, and we're proud of it!"

Constancy of purpose in management, unification of members, and pride among the work force resulting from the mission statement can best be achieved if the wording of the mission statement focuses on quality, continuous improvement and customer satisfaction. Ultimately, these concepts are the heart of a TQM organization and the mission statement, the touchstone for all organization activity, should reflect this focus. Related to this concept is the view that employees, their ideas, knowledge and experience, are resources critical to the organization's success. The mission statement should reflect the fact that continual development of the work force is of vital interest to the organization as a whole.

Another concept related to the content of the mission statement is the need for it to express the long-term view of the organization. Although the mission statement should change as often as necessary to reflect changing demands on the organization, each time it should be written as if it were going to be permanent. The mission statement should have an emphasis on long-term objectives of resource placement in the areas of training, research, education and improvement. Just as the U.S. Constitution takes a long-term view of how government works, leaving the nuts and bolts of staffing and salary to lesser laws, so the mission statement of an organization should relegate the short-term objectives to lower level documents.

### Visioning

Visioning, like many terms associated with TQM, does not have a good formal definition. In our experience, however, it has two basic meanings, both of which are closely tied to the idea of a mission statement.

The first usage is in relation to a shortened version of an organizations mission statement. As explained in Weaver & Upton, 1992b, mission statements range between detailed, multi-page documents that express the why, who, what, and how of an organization, to short, slogan-style statements that are easy to memorize and carry around. When an organization desires to have the benefits of both types, often a vision statement is a method of accomplishing this. The vision statement is a general slogan-style statement of the organization's mission and the mission statement provides the detail that the vision statement lacks.

The second usage views the vision statement as the organization's "castle in the air" and the mission statement as the foundation under it. Often the two usages overlap. The Air Force Human Systems Division's "There Are No Unmanned Systems" or Military Airlift Command's "Proud MAC -- Support America Can Always Count On" are not real mission statements, but they are the guiding principles upon which their mission statements are based. In conjunction with a mission statement that expands on it, a vision statement can be a valuable tool for workers and management as they consider what they are doing, providing a simple, concise aim to focus on.

### The Mission Statement and TQM/MGEEM

In a TQM/MGEEM effort, review of the mission statement is always the first order of business, both for the measurement development group (Blue and Gold teams) as well as the feedback team. Everything done in a TQM/MGEEM effort is tied to the mission statement. The mission statement is the first output developed by the Blue Team. It serves as the basis for discussion of customers and suppliers. KRAs are identified by breaking the mission



statement into critical, measurable parts and the ME chart slopes reflect the relative criticality of the indicator to accomplishment of the key parts of the mission. Feedback sessions start with review of the mission statement both to check the acceptability of the wording and to focus the team's thinking on what is critical -- the mission of the organization.

Everything else in a TQM/MGEEM effort is founded on the mission statement and the mission statement's quality will ultimately determine the quality of everything else in the system. It is, therefore, imperative that organizational members take sufficient time to ensure the mission statement's quality and be willing to alter it when necessary in order to reflect changes in their environment that affect their mission. With a quality mission statement in hand, the organization is ready to use the Nominal Group Technique to begin development of the rest of the outputs of the TQM/MGEEM process.

### The Nominal Group Technique (NGT)

The NGT is a consensus building tool used in the strategic planning and measurement phases of the TQM/MGEEM development process (see Delbecq, Van de Ven, & Gustafson, 1975). The NGT consists of posing a nominal question, silent generation of answers, round-robin listing of the proposed answers, discussion and clarification, voting, and documentation of results.

### The Role of the Facilitator

In both phases of the TQM/MGEEM development process, a team is formed to undertake the work. (The membership and duties of these teams will be discussed in a following section, "An Overview of TQM/MGEEM.") The member of this team responsible for guiding the other members through the TQM/MGEEM process is the Facilitator. The facilitator's job is eased by the fact that he/she need not be an expert in the work of the organization to fulfill his role, he need only be able to work in front of a group of people and know the TQM/MGEEM process itself, especially the NGT. The hardest part of being a facilitator is maintaining the necessary neutrality through the process. Because the facilitator is the one controlling discussion and acting as process expert for the TQM/MGEEM process, any opinion they might advance takes on significant added weight, enough so that if they step too far from a neutral position, the teams can lose their sense of ownership of the outputs of their efforts. This can be disastrous to the TQM/MGEEM effort. For this reason and because the facilitator need not be a work-matter expert, we suggest that the facilitator be from outside the organization. This eases the strain on the facilitator and allows all the members of the organization itself to take part in the process without requiring one of them to take on a forced, unnatural neutrality on these important topics.

### Posing the Nominal Question

The facilitator begins the NGT by posing a question such as, "Who are this organization's key customers?" Participants are then asked to silently generate answers to the question posed by the facilitator. Silent generation means to write answers to the nominal question without assistance. This process is important because it taps creativity and the results serve as the primary content for the remainder of the NGT process.

### Round-robin Listing

In round-robin listing, answers generated during silent generation are recorded on chart paper. This process is conducted without comment or discussion, except as needed to aid the facilitator in accurately and legibly recording the answers. The facilitator moves around the group in round-robin fashion, getting one answer from each participant. This process continues until all participants pass, showing that all of their answers have been recorded.

### Discussion and Clarification

Once all of the answers have been listed, the facilitator leads the team through a review process. The purpose of this review is to provide an opportunity to discuss items on the list. This review improves the team's understanding of the items, reduces redundancy, and usually reduces the size of the list. During this step, participants are urged to ask questions to clarify the items.

### Voting and Documentation of Results

Participants are next asked to select the items from the final list they feel are the most important for the unit. Through voting, the team reaches consensus on which are most important to the organization. The voting results are then documented for further reference. Two suggested voting techniques are described below, however there are a number of useful alternatives available and if a group or facilitator wishes to make use of a different technique they are encouraged to do so.

Voting for Ranking Only. This technique is used in the customer and supplier ranking votes. Its purpose is to provide a rough idea of the group's feelings as to which items in a list are the most important. Simply put, this technique uses a number of voting slips (3x5 cards or similarly sized pieces of paper) for each participant. Each team member takes the slips and places one of the items from the list on each slip. The voting slips are turned in and the number of votes for each item is reported back to the group.

Voting to Reduce Options. This is a more precise way to determine the importance of various items in a list. The steps are the same as for the previous voting technique until all participants have their voting slips filled out. Each participant then takes the slips and rank orders them. This can be done in a number of ways. The following discussion illustrates the method we most commonly use. Tell each person to place their voting slips face up in front of them so that they may examine them all at once. As they then examine the choices they have on the voting slips in front of them ask them, "If you could have only one of the choices in front of you, which one would it be?" Each participant then gives this choice a number of points equal to the number of votes they are casting. For example, if each participant has three choices, this first choice would receive three points, if they have seven choices, the first choice would receive seven points. After they have given a point value to their first choice instruct them to turn the slip face down in front of them. Next ask the participants, "Of the choices left face up in front of you, which one do you think is the least important?" This choice is given one point (the lowest value) and again turned face down. The exercise is then repeated for the most important remaining choice (which receives one fewer point than the previous most important) and for the least important remaining choice (which receives one more point than the previous least important choice). This process continues until all the choices have been given a point score ranging from one (for the least important) to the number of choices available to each participant (for the most important). For an example of how this technique is used see Weaver & Upton, 1992b.

## How TQM/MGEEM Is Used To Implement TQM

### An Overview of TQM/MGEEM

TQM/MGEEM consists of four basic phases. The first phase is prerequisite to the process and its continuation is essential to the ongoing quality effort. This Commander Involvement phase is dealt with in some detail by Weaver & Upton (1992a). The second and third phase are transitional phases. It is during these phases that the Blue and Gold Teams meet and develop a rational measurement system for use by the organization as a basis for improvement. These two phases are dealt with in more detail by Weaver & Upton (1992b). The final and continuing phase of TQM/MGEEM is one of feedback and continuous improvement. It is here that the TQM philosophy is applied to the organization's environment itself and the great benefits of a TQM/MGEEM implementation are realized. This final phase is dealt with in more detail by Weaver & Upton (1992a&c).

Phase 1: Commander Involvement. This is the entire subject of Weaver & Upton, 1992a and the reader is encouraged to refer to that

report for more on this subject. Suffice it to say at this point that this is the critical element of any TQM effort. Without sufficient commander involvement, a TQM effort is doomed to die a slow and agonizing death. With sufficient commander involvement, almost any TQM plan, even one less robust than TQM/MGEEM, will have substantial positive effects on the organization.

Phase 2: Blue Team. The facilitator begins the second phase of the TQM/MGEEM process by convening the Blue Team. This team is composed of the commander of the target organization, his or her immediate subordinates, and selected representative customers and suppliers.

The facilitator leads the Blue Team through a systems analysis. The purpose of the analysis is to make everyone aware of the mission, customers, suppliers, inputs, value adding activities, and outputs (products) of the target organization. Here the teachings of TQM philosophers, especially Deming (1986) and Juran (1989) should be incorporated into the presentation. The aim of TQM/MGEEM is to increase organizational performance. Performance, as mentioned earlier, is defined as improving efficiency and effectiveness. The systems analysis directs the Blue Team's focus on those aspects of the organization which are important for performance improvement.

(1) Mission Statement. In this first part of the strategic planning phase, the Blue Team develops or refines their organization's mission statement. The mission statement serves to direct the development of KRAs and indicators which support organizational goals. This work focuses the team's attention and encourages constancy of purpose, Deming's (1986) first point.

(2) Identification of Key Customers/Suppliers. The Blue Team then identifies critical customers and suppliers through use of the NGT. This exercise is an opportunity to discuss important TQM contributions related to customers and suppliers. These include Deming's (1986) points 2 and 4 and Juran's (1989) definition of customer and TRIPROL. This also helps to focus the team on exactly what they do and what is important to them. It also serves as a resource later, during feedback, to solicit input from both customers and suppliers in order to improve the organizations processes.

(3) Key Result Areas (KRAs). Key Result Areas (KRAs) are the measurable aspects of an organization's mission and follow from the mission statement. From the viewpoint of the external environment, KRAs are the reasons the organization exists. Thus, higher-level organizations, customers, and suppliers have expectations that the target organization will produce certain products or services or will maintain a state of readiness sufficient to perform certain activities. Stated in measurable terms, these expectations are the KRAs for an organization.

To generate KRAs the facilitator asks the members of the Blue Team to assume that they are commander for a day. The facilitator then poses the question, "What does the Air Force pay this organization to do?" Answers are clarified and prioritized using the NGT. The resulting KRAs represent the principal intended accomplishments of the organization. Development of 5 to 7 KRAs concludes the work of the Blue Team.

Phase 3: Gold Team. Indicators. The measurement phase of TQM/MGEEM begins with the Gold Team formed of the commander's subordinates and key workers.

(1) Indicator development. Members of the Gold Team are also asked to play commander for a day, and the facilitator shows them each KRA, in turn, and asks what the commander needs to know to determine how well the organization is doing on each. Answers, called indicators, are identified and clarified using the NGT. For each KRA there is usually one to three indicators. Examples of KRAs and indicators are shown in Table 1 (see the Appendix I for additional examples).

**Table 1. KRAs and Indicators: Jet Engine Repair Shop.**

<u>KRA</u>	<u>Indicator</u>
Keep engines in ready/ serviceable condition	Percent of inspections passed
Make repairs in a prompt/ timely manner	Days required to repair jet engines
Complete projects on time	Percent of suspenses met

Immediately after each indicator is identified, the facilitator guides the Gold Team to a consensus about the Feasible Worst (FW), Feasible Best (FB), and Indifference Point (IP) values for each indicator. For example, using the indicator "Percent of inspections passed" the Gold Team may determine that the feasible worst they could expect to do is 40%, the indifference point (neither good nor bad performance) is 60%, and the feasible best they could expect to do is 100%.

(2) Indicator Weighing Table. After identifying indicators for all of the KRAs, the facilitator guides the Gold Team to construct an Indicator Weighing Table. The indicators are listed with their Feasible Worst (FW), the Indifference Point (IP), and the Feasible Best (FB) values. The indicators are given a rank order according to overall importance to accomplishing the mission. The Gold Team then makes a determination as to the relative

importance to mission effectiveness of each indicator. For example, the indicator most important (ranked 1) to mission effectiveness is given +100 mission effectiveness points. The effectiveness points for the remaining indicators ranked 2, 3, etc., are then determined relative to the indicator ranked number 1. More than one indicator can be given the same rank and effectiveness points. An example of an Indicator Weighing Table based on the indicators in Table 1 is in Table 2.

**Table 2. Indicator Weighing Table.**

Indicator	Feasible Worst (FW)			Feasible Best (FB)			Indifference Point (IP)
	#	Rank	EP*	#	Rank	EP*	
Percent of inspections passed	40%	3	-25	100%	3	+25	60%
Days required to repair jet engines	60	1	-100	5	1	+100	30
Percent of suspenses met	50%	2	-75	95%	2	+70	70%

\*EP: Effectiveness Points

3) ME Charts. The Gold Team continues its work in the measurement phase by constructing graphical representations of the relationship between performance on each indicator and overall organizational effectiveness. These representations of team consensus are the Mission Effectiveness (ME) charts. ME charts display not only current levels of performance but also show where the organization can improve. ME charts are also used as a series of powerful tools for improved management and to involve workers in identifying performance barriers. Use of ME Charts for this purpose is explained in Weaver & Upton, 1992c.

Figure 4 shows the standard form of an ME chart. An ME chart is developed for each indicator. Differences in importance among indicators is accounted for through the use of the indicator weighing table. The facilitator labels the X-axis with the name of an indicator, placing the worst feasible performance value on the left and the best feasible performance value on the right. For instance, the X-axis label of feasible worst and best values for the indicators in Table 2 are: (1) for inspections passed, from 40

to 100 percent; (2) for time required to repair jet engines, from 60 to 5 days, and (3) for percent of suspense dates met, from 50 to 95 percent (See Fig 5). The feasible worst and best values are the first two points on the curve on an ME chart. The Y-axis is overall mission effectiveness labeled from -100 at the bottom through 0 to +100 at the top in increments of 10.

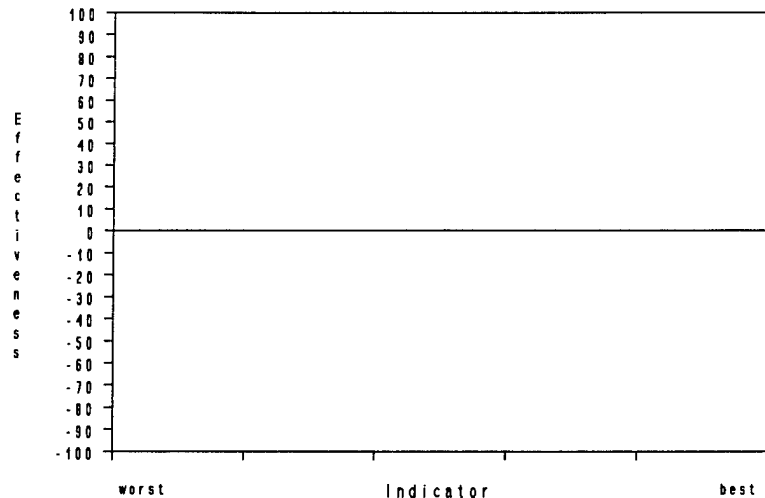


Figure 4. Standard form of ME Chart.

The indifference point is the third point plotted on the ME chart for each indicator. This point represents the level on the indicator (X-axis) that has no impact, positive or negative, on organizational effectiveness (Y-axis). Another way to describe this point is the level of performance on the indicator that won't cause management to commit more resources, or reduce resources. This point on the X-axis is the zero point on the Y-axis. Sometimes it is more useful to use a indifference zone instead of a single point i.e. a range of values on the X-axis that correspond to zero effectiveness points on the Y-axis (an example can be found in Appendix I, Repeat/Recurring Discrepancies).

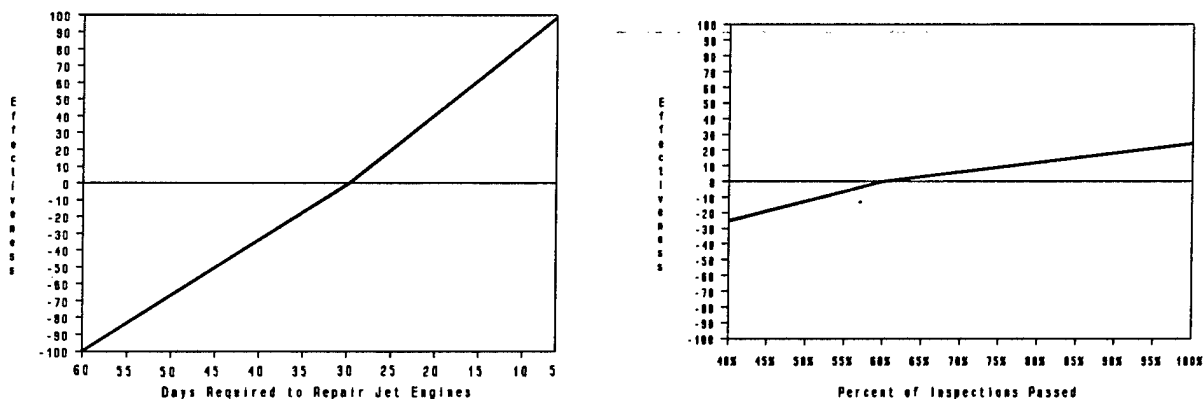
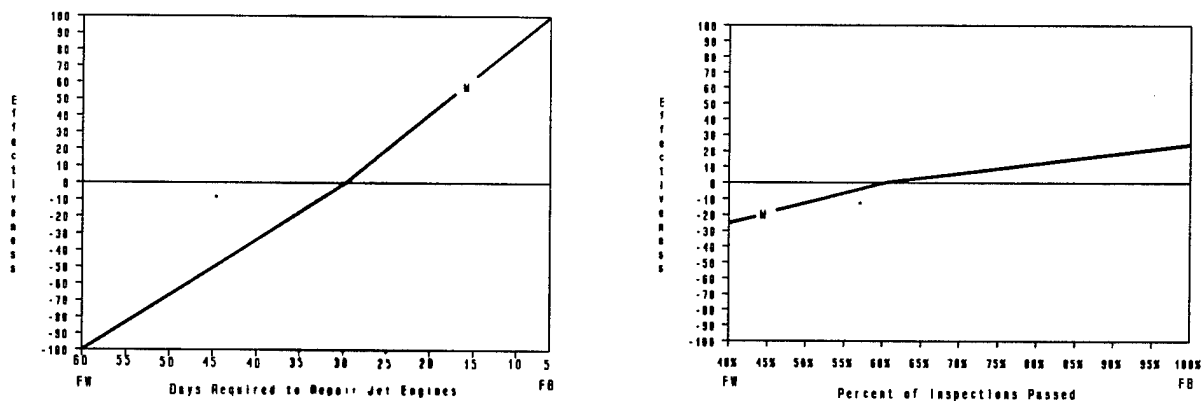


Figure 5. Completed ME Charts.

The facilitator continues filling in values on the curve on an ME chart by asking the Gold Team to reach consensus on the impact on effectiveness of other levels of the indicator. This questioning continues until the relationship between the indicator and

effectiveness is captured. Curves on ME charts can be linear or nonlinear. These curves reflect consensus of the Gold Team on the impact on mission effectiveness of different levels of performance on indicators. There is one ME chart for each indicator showing the relationship between levels of performance on indicators (on the horizontal axis) and the target organization's overall mission effectiveness (on the vertical axis). ME charts are submitted for review and approval to higher management. Figure 5 shows completed ME charts for the indicators "Days required to repair jet engines" and "Percent of inspections passed." The first indicator is shown by its steep slope to be very important to effectiveness; the second's relatively flat slope displays its lesser importance.

**Phase 4: Feedback.** The last and continuing phase of TQM/MGEEM, feedback, involves using information posted periodically (usually monthly) on ME charts. These charts provide a basis for improved management and for soliciting worker inputs to identify barriers to greater performance. Feedback of performance is a highly useful way to improve performance.



**Figure 6. ME Charts: One Month's Performance Data.**

Indicator data are collected and plotted on the ME charts. Members of the target organization receive periodic feedback on how they perform as a group on their ME charts. For instance, Figure 6 shows ME charts with one month's performance data plotted for the indicators "Days required to repair jet engines" and "Percent of inspections passed." Suppose, last month's performance on the two indicators in Figure 5 was 15 days to repair jet engines and 45% of inspections passed. These results are posted (in Figure 6 with a letter representing the month: here M for May) on ME charts and provided as feedback. These results show that the work center is doing well on the most important aspect of its business (shown by the steep slope), repairing jet engines. A 15 translates into +65 effectiveness points (on the vertical axis) and shows that there is room for improvement, but, in general, that the work group is doing well on this indicator. On the second, but relatively less



important (shown by the flatter slope) indicator, however, 45% of inspections passed shows that this second aspect of business is not being accomplished very well. Completing 45% of inspections (on the horizontal axis) has a negative impact of -20 on mission effectiveness (on the vertical axis). (A computer program (Upton, 1990) is available to aid in ME chart construction). More detail on how to use ME Charts and feedback data can be found in Weaver & Upton (1992c).

#### TQM/MGEEM's Measurement System

In addition to being a framework for implementing TQM, TQM/MGEEM provides commanders and managers with a comprehensive organizational performance measurement and information system. This system includes tools for improved management and increased worker morale.

Benefits of ME charts. The additional benefits of TQM/MGEEM are derived from use of the ME charts. TQM/MGEEM is an organizational performance measurement system because ME charts provide measures for managers and workers which allow them to monitor how well they are doing in accomplishing their KRAs. In addition, measures on ME charts can be rolled up so higher level managers can be informed concerning the overall performance of two or more subordinate units (Weaver & Looper, 1989). The measures of performance used in TQM/MGEEM can include traditional measures available from accounting and engineering but can also go beyond their limitations. It is these non-traditional measures, such as timeliness and customer satisfaction, that Dr. Deming says are so important (Deming, 1986).

TQM/MGEEM is an information and improvement system because, in addition to their measurement capabilities, ME charts provide signals that problems exist and that problems are solved. This, of course, makes teams more effective because the charts point to problem areas where teams should be set up. ME charts also measure the results of the teams' efforts to correct problems. Furthermore, ME charts guide resource allocation. Indicators with charts with steep slopes (showing that the indicator is important to effectiveness) are usually the first to benefit from new resources and the last to give resources up. For example, the slopes on the ME charts in Figure 6 show that time required to repair jet engines is more important to mission effectiveness than percent of inspections passed. When the work center performs as well as feasible on both Indicators, "5 days to repair a jet engine" has a +100 impact on mission effectiveness while passing "100% of inspections" has only a +25 impact on the mission. Thus, comparing the slopes on the ME charts shows the organization's policy about the importance of the two Indicators: repairing jet engines is more important than passing inspections. This is not to say that the work center can neglect inspections. Passing less than 60% of

inspections has a negative impact on mission effectiveness, but is not so serious as a delay in repairing jet engines.

Feedback Involving Workers. In TQM/MGEEM all members of the target organization (managers and workers) make up a feedback team. This means there are permanent "feedback teams" in every target organization, and everyone is a member of a feedback team.

Periodic, usually monthly, "feedback sessions" among feedback teams are perhaps the most important feature of TQM/MGEEM. As soon as current performance results are posted on ME charts, the charts are provided to the personnel of the target organization. The charts are displayed in the work area and then distributed at monthly meetings of all target organization personnel. The manager should be present throughout the meeting, along with other members of the work center and customers and suppliers, as needed. (In a large target organization personnel may attend on a rotating basis, say every other month.) Everyone would have frequent opportunities to attend and get in their "2 cents worth." No member of the target organization should be left out of the feedback sessions. At these meetings the supervisor should encourage feedback about how to improve target organization performance as monitored on ME charts. The managers should listen to the suggestions of personnel. Personnel should be asked, "What keeps us from doing a better job on our ME Charts, especially those with steep slopes? What holds us back?"

Team building activities and teamwork should be encouraged in feedback sessions. Managers should not look for someone to blame for a performance problem, but should seek ways to improve the work processes involved. It is important that everyone understand that the indicators on each ME chart are driven by a process. When a process for a given ME chart is not understood a cause-and-effect diagram may be used to develop the insight (Brassard, 1988). Managers must understand that personnel want to do a good job. They want to take pride in their work. Consequently, it is important that managers continually seek to improve all parts of their processes rather than focusing exclusively on workers. In fact, the purpose of management, according to TQM Philosophy, is the optimization of the system (Deming, 1991). That means that a manager's job is the identification and removal of barriers between departments and barriers to pride in workmanship.

Process Improvement Teams (PITs). As feedback teams work to improve the processes which drive the values on ME Charts, they often realize that various barriers to improvement extend beyond the boundaries of their target organization and its authority. Such problems are worked by a second type of team, called a PIT. PITs are initiated by management when a problem that extends across the boundaries of two or more target organizations is identified. The membership of a PIT includes an advocate from the commander's staff who represents the team to the commander and representatives

from each functional component involved in the process. A subject matter expert and an action officer responsible for day-to-day measurement and reporting should also be PIT members.

Using Teams to Improve Work Processes. Neither the feedback team, the PIT, nor management itself use judgment alone to identify barriers or processes that require attention. Instead, these teams and individuals use the slopes on ME charts, with the aid of TQM theory, to identify barriers. Poor performance (i.e., an identified barrier) on a steeper slope should usually be worked before poor performance (a barrier) on a flatter slope.

Management must take seriously suggestions which result from feedback sessions by improving the systems by which work is accomplished. Managers must insist that teams furnish solid evidence (i.e. data) to substantiate their recommendations for process improvement and the removal of barriers. Conversely, when teams do furnish such evidence, it is incumbent on the manager to make the suggested changes. The old excuses for inactivity ("If it ain't broke, don't fix it," "That's how it's always been done," etc. ad nauseum) are no longer valid. According to TQM philosophy, workers produce outputs and managers continuously improve processes. This often requires a new philosophy of leadership at all levels. Feedback through ME charts motivates workers and management to higher levels of performance.

Feedback to Higher Command Levels. Because ME charts transform indicators to the common scale of effectiveness (the Y-axis), effectiveness points from ME charts can be summed. This summation can be used to measure a target organization's overall performance or to compare the performance of different target organizations. Measures of target organization can also be rolled-up to gauge the overall performance at a higher level of the organization. See Weaver and Looper, -1989, for a complete guide to the aggregation of ME charts.

TQM/MGEEM Teams Incorporate Current TQM Philosophy. Both types of TQM/MGEEM teams use the Deming Cycle (Fig 7) to identify and recommend to management solutions to process problem and removal of barriers to performance (Walton, 1986). ME charts are used to study processes objectively and identify barriers to performance improvement. Appropriate changes are made, indicator data continue to be collected, and the effects of the change are observed. Teams meet regularly to study the

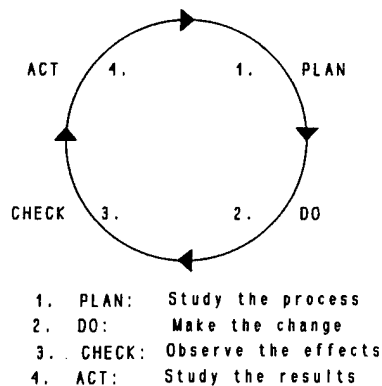


Figure 7. The Deming Cycle.

results of changes. The cycle is then repeated and is the basis for continual improvement of work processes. The Deming Cycle can be applied to any process. Use of the cycle leads to continual improvement of work methods and procedures. For more information about the Deming Cycle (or Shewhart Cycle) see Walton (1986, pp. 86-88) and Deming (1986, pp. 88-90).

Members of both types of TQM/MGEEM teams should be trained in the use of the 7 tools (Ishikawa, 1982; Brassard, 1989) and team problem-solving techniques (Scholtes, 1990). Familiarity with Dr. Juran's teachings may also be useful (Juran, 1989). TQM/MGEEM teams should understand that 90% of problems can be worked successfully with simple statistical tools, not including the control chart. They are, however, taught and encouraged to use control charts where appropriate and to apply Shewhart's perspective of special and common causes (see Deming, 1986; Walton, 1986; Scherkenbach, 1988). These techniques allow teams to identify and leave alone stable, predictable systems.

#### TQM/MGEEM and Dr. Deming's 14 Points

TQM/MGEEM provides a method to put TQM philosophy into action. While many have contributed to TQM, its philosophical leader is Dr. W. Edwards Deming. A substantial part of his contribution to TQM is his famous 14 points. Following a statement of Dr. Deming's 14 points is a brief explanation of how TQM/MGEEM can help implement TQM. For a complete treatment of Dr. Deming's points, see Deming, (1986); Gitlow & Gitlow, (1987); Scherkenbach, (1988); and/or Walton, (1986).

**Point 1: Create and publish a statement of the aims and purposes of the organization. Management must demonstrate to all employees their constant commitment to this statement.**

Target organization members-- establish and/or review the organization's mission statement and become involved in strategic planning. Reviewing the mission in the TQM/MGEEM process is important because Deming observes that probably 80% of America's workers don't know their job and are afraid to ask (Mann, 1985, p.101). For expansion on this important point see the preceding section titled "The Importance of the Mission Statement."

**Point 2: Learn the new philosophy: top management and everybody.**

TQM/MGEEM provides a structured process to identify customers and suppliers. Customers and suppliers are invited to periodic feedback meetings. Customers are encouraged to evaluate how well the target organization is meeting their expectations and suppliers are provided with information that allows them to form a more harmonious relationship with the target organization. Periodic feedback sessions provide reinforcement of the Deming philosophy of continual improvement for quality.

**Point 3:** Understand that the purpose of inspection is improvement of processes and reduction of cost.

This point is woven throughout the TQM/MGEEM process. Emphasized throughout the Blue and Gold Team activities (Weaver & Upton, 1992b) is a continuing refrain that the purpose of measurement (inspection) is to serve as a basis for improvement, not a hammer to make people "do it right the first time." Additionally feedback team discussions of ME charts allow quality to be built into the product or service by improving work processes instead of simply relying on inspection to weed out the defects.

**Point 4:** End the practice of awarding business on the basis of price tag alone.

Under the current laws governing the Air Force procurement system, this point can not be fully implemented. However, TQM/MGEEM uses system analysis to identify suppliers and the contribution they make to quality; a contribution that goes beyond the price tag to include cooperation. It also encourages participants to think of their organizations as systems instead of traditional collections of individuals. Finally, feedback sessions with other government agencies build a more harmonious relationship with them, thereby improving quality.

**Point 5:** Improve constantly and forever the system of production and service.

In regular feedback sessions target organization personnel seek greater cooperation with their suppliers and strive to improve the processes by which they seek to satisfy the expectations of their customers. All of these players (target organization personnel, suppliers, and customers) can attend these sessions.

**Point 6:** Institute training.

During TQM/MGEEM feedback sessions, training deficiencies are identified as barriers to performance. Workers are in a good position to identify aspects of their jobs and their process that could benefit from additional training. The TQM/MGEEM process itself provides excellent opportunities for discussion, training and practice of Quality ideals. Other ideas on training are addressed by Weaver & Upton (1992a).

**Point 7:** Teach and institute leadership.

It is estimated that no more than 15% to as little as 1% of organization problems can be corrected by workers. This leaves management with the responsibility for problem correction through changes in the system (Mann, 1985, p. 7). TQM/MGEEM is a management tool to bring about these changes as it provides forums, such as the Blue, Gold, and Feedback Teams in which managers may practice TQM's approach to leadership.

**Point 8:** Drive out fear. Create a climate of trust.

The participatory aspects of TQM/MGEEM encourage two-way communication to drive out fear. The emphasis of TQM/MGEEM is on

achieving consensus to improve process, instead of blaming workers. A variety of forums are provided in which managers can seek to drive out fear.

**Point 9: Optimize the efforts of teams, groups, and staff areas toward the aims and purposes of the organization/company.**

The nature of the Blue and Gold teams, drawing together individuals from throughout the organization to work together to form a common perspective and consensus can do much toward beginning this optimization effort. PITs bring together workers from different organizational levels and departments. This encourages constructive communication and helps break down barriers.

**Point 10: Eliminate exhortations for the work force.**

Most performance problems result from inadequacies in the way an organization does its business, not from people unwilling to work hard. It is, therefore, a waste of time to expect to get lasting gains in performance by exhorting subordinates to work harder. Rather than asking personnel to work harder, supervisors must accept responsibility for simplifying and streamlining the way work is done. TQM/MGEEM provides the tools to accomplish this.

**Point 11a: Eliminate numerical quotas for production. Instead, learn and institute methods of improvement.**

No quotas are recommended in the use of ME charts. Instead, personnel are taught that indicators on ME charts are driven by processes. They are taught to identify and continually improve the components of the process.

**Point 11b: Eliminate M.B.O. Instead, learn the capabilities of processes and how to improve them.**

Managers learn through TQM/MGEEM that Management by Objective (M.B.O.) as it is commonly practiced is inappropriate and counter-productive. To set objectives for workers when they have little control over the process will not increase quality, but instead will have severe negative consequences. Instead managers must learn the capabilities of processes; of which workers are but one part, and seek to continually improve these processes so that the processes' capabilities increase.

**Point 12: Remove barriers that rob people of pride of workmanship.**

Through feedback from workers, customers and suppliers, TQM/MGEEM gives management the opportunity to identify the barriers in work processes that can be improved. It is management's responsibility to remove these barriers.

**Point 13: Encourage education and self-improvement for everyone.**

Managers using TQM/MGEEM must understand that in an ever-changing, increasingly demanding world, adaptable and innovative

workers can only be developed through continual education and self-improvement. This kind of education extends beyond training for the skills required by their present jobs.

**Point 14: Take action to accomplish the transformation.**

All members of an organization, from top management through middle management to the worker level, are involved in building a TQM/MGEEM system. Through the Blue and Gold team meetings and the later Feedback Teams, all members of the organization are given the opportunity to make TQM happen. It is especially important to understand that the commander cannot delegate responsibility for making quality happen. While other personnel are empowered in quality, the ultimate source of quality emanates from the commander's understanding and practice of TQM philosophy.

**Pitfalls to be avoided**

As is the case with any organizational development strategy, there are potential problems. Dr. Deming (1989) has drawn on his extensive experience to discuss such pitfalls in his treatment of deadly diseases and obstacles. Commanders who are serious about implementing TQM/MGEEM must study and understand Deming's teachings on this subject. Many of these pitfalls can be avoided or resolved, however, through judicious use of TQM/MGEEM. This section draws on field experience with TQM/MGEEM to offer guidance on two pitfalls that are of special concern to a TQM/MGEEM implementation and how they can be avoided.

**Fear of Being Measured.** Individuals often express fear and anxiety about the measurement of their performance, but these fears must be lessened. One such concern is the fear of failure. This can be dealt with by encouraging groups to use performance measurement data as a basis for gradual-but continual improvement. A second fear is repercussions from higher headquarters. This is often grounded in a history of having been "called on the carpet" for a performance problem, inspection report, customer complaint, etc. The facilitator can reduce this fear in two ways. First, this fear is reduced by including the next higher level commander on the Blue Team. This tends to ensure approval at the next higher level and will help break down barriers and increase understanding. Second, reports submitted to the next hierarchy level can be summaries that do not provide detail on each indicator tracked. This reduces the potential for micro-management from above. For example, an agreement might be struck with the next higher level commander that reports submitted include only an aggregate performance index and show only change from a baseline period. This would provide a degree of insulation for the lower level commander, but still ensure accountability.

**Gaming the System.** As with any measurement system, there is a potential for gaming. Individuals can be very creative about

giving a commander what he or she wants to see. Overcoming this tendency must attack the motivation to fake rather than try to make the system fake proof. Much of what has been said above deals with this issue. Reducing the fear of higher headquarters intervention, involving the organization in the development of the measurement system, and creating an environment which encourages continual improvement are all efforts to reduce the motivation to game the system. If members of the organization feel that they own the system, there is less motivation to game it.

### A Call To Action

TQM/MGEEM is not, to use Dr. Deming's words, "instant pudding". It is neither quick nor easy. It requires constant, visible, never-ending commitment from top leadership and often nothing short of a complete revolution in the culture of the entire organization. These are not changes that will occur overnight, or in a matter of weeks or even months (although some gains should be visible in that short a time). Although effectiveness improvements may be evident in the short term, to change the organizational culture will require years of effort and significant investments in time, resources, and manpower. The increase in quality and mission effectiveness of Air Force organizations; however, is well worth the effort and the commanders that take the lead in implementing these ideals will be remembered as examples for the rest of the Air Force and the entire DoD to follow.



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- Tuttle, T.C., Wilkinson, R.E., & Matthews, M.D. (1985, August). Field test of the methodology for generating efficiency and effectiveness measures. (AFHRL-TP-84-54, AD-A158 183). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.
- Upton, M.T. (1990). MGEEM: The software. Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.
- Walton, M. (1986). The Deming management method. New York: Dodd, Mead.
- Weaver, C.N. (1991). TQM: A step-by-step guide to implementation. Milwaukee WI: ASQC Quality Press.

- Weaver, C.N., Looper, L.T. (1989, May). Methodology for generating efficiency and effectiveness measures (MGEEM): A guide for the development and aggregation of mission effectiveness charts. (AFHRL-TP-89-7, AD-A208 353). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.
- Weaver, C.N., Upton, M.T. (1992a). Implementing Total Quality Management (TQM) I: The command imperative. (AL-SR-92- ). Brooks AFB, TX: Manpower and Personnel Research Division, Armstrong Laboratory.
- Weaver, C.N., Upton, M.T. (1992b). Implementing Total Quality Management (TQM) II: A facilitator's guide. (AL-SR-92- ). Brooks AFB, TX: Manpower and Personnel Research Division, Armstrong Laboratory.
- Weaver, C.N., Upton, M.T. (1992c). Implementing Total Quality Management (TQM) III: Feedback and continuous improvement. (AL-SR-92- ). Brooks AFB, TX: Manpower and Personnel Research Division, Armstrong Laboratory.

## Appendix I: Examples From TQM/MGEEM Systems

The following examples were drawn from actual TQM/MGEEM implementations. Some editing has occurred in order to preserve the privacy of the specific units that developed them.

### Mission Statements

#### Operations Support Branch (Supply):

Continuously provide quality supply support to base-wide customers at the lowest practical cost and ensure that required material is available prior to actual need.

#### Military Airlift Squadron:

Provide combat-ready aircrews for strategic airlift and tactical airdrop missions.

#### Aerial Port Squadron:

Provide quality passenger and cargo movement, combat airdrop training support and other transportation services for DoD, government and civilian agencies. Provide logistical support and training to off-shore locations. Provide a safe, quality working and learning environment conducive to individual growth and pursuit of excellence. Continually and forever improve all processes and services.

#### Supply system Process Improvement Team:

Facilitate customer support by solving supply system problems.

#### Aircraft Maintenance Unit:

Responsible for providing mission-ready aircraft and quality trained personnel to meet the requirements of the wing.

#### Air Force Laboratory Division:

Conduct human systems R&D to identify, develop, and evaluate technologies to enhance the quality of Air Force technical training and education, the job performance capability of AF personnel and, thereby, the combat capability of our forces.

### Key Result Areas

#### Aircraft Maintenance Unit:

- Identify and provide training.
- Perform quality maintenance.
- Provide technical data and equipment.
- Documentation.
- Safety.
- Promote Unit Morale.
- Communication.

Vehicle Operations Branch:

- Provide quality, on-time dispatches.
- Manage personnel.
- Provide adequate number of vehicles.
- Practice good vehicle care.
- Monitor VCO/VCNCO program.

Military Airlift Squadron:

- Provide quality training.
- Maintain force structure requirements.
- Meet mission taskings.
- Provide quality information system.
- Provide for quality of life needs.
- Provide quality administrative support.
- Safety.

Aerial Port Squadron:

- Provide for quality movement of cargo and passengers.
- Customer Satisfaction.
- Provide needed training.
- Provide good working environment.
- Facilitate communication.
- Maintain and upgrade facilities/equipment.

Repairable item management team:

- Accurate system file maintenance.
- Supply quality items to users in a timely manner at the best price.
- Implement an accurate budget execution through procurement and repair.
- Quality asset management, retention and disposal.

Computer Support Branch:

- Provide Statistical and Data processing Products.
- Provide Software and Documentation.
- Provide Computer Services.
- Maintain Historical Data Bases and Layouts.
- Provide Quality work environment.

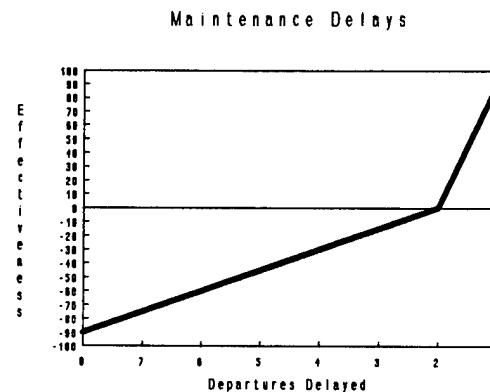
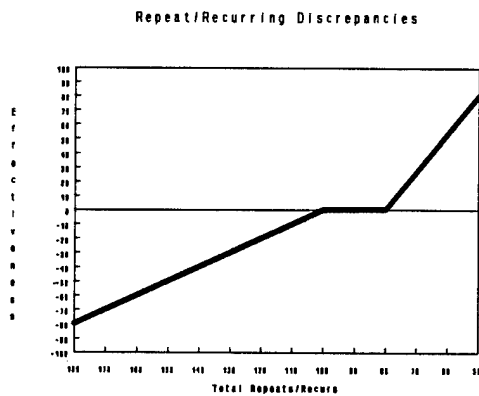
## Indicators and ME Charts

### Aircraft Maintenance Unit:

KRA: Provide Quality Maintenance

Indicator A -- Repeat/Recurring Discrepancies

Indicator B -- Maintenance Delays

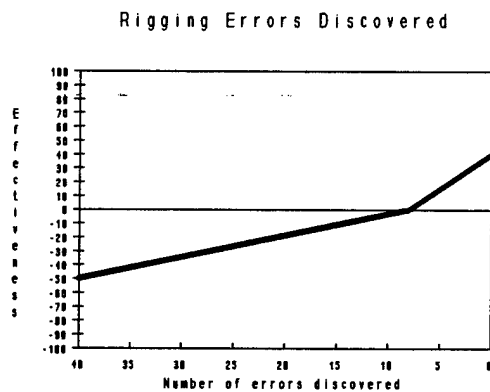
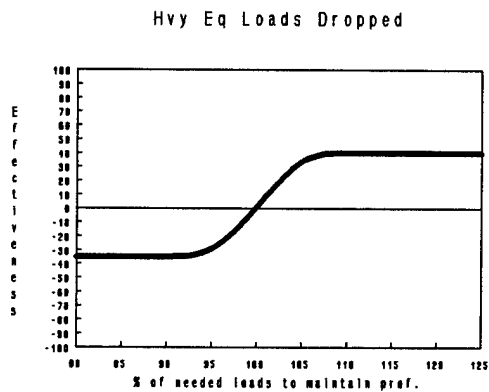


### Aerialport Squadron:

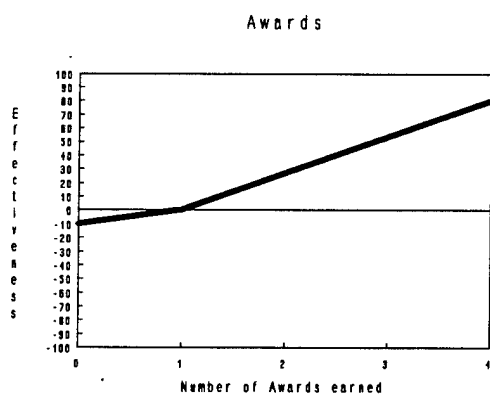
KRA: Provide Quality Airdrop Training

Indicator A -- Percent of Heavy Equipment Loads dropped to maintain proficiency

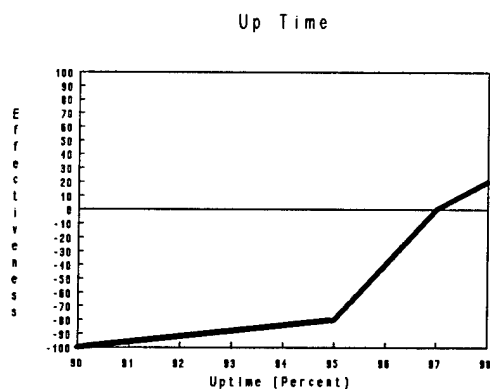
Indicator B -- Number of Rigging Errors discovered



Computer Support Branch:  
KRA: Maintain High Worker Morale  
Indicator -- Number of awards



KRA: Provide Computer Services  
Indicator -- Up Time



## Appendix II: Annotated TQM Bibliography

### The Philosophy of Dr. W. Edwards Deming

- Deming, W.E. (1986). Out of the crisis. Cambridge MA: MIT.  
The "Bible" of TQM philosophy. Explains the Deming Philosophy in depth with numerous examples, ideas and a resounding overall call for radical change in Western management practice. A must for any knowledgeable TQM agent, it is best read after Mary Walton's The Deming Management Method, William Scherkenbach's The Deming Route to Quality and Productivity, and Gitlow & Gitlow's The Deming Guide to Achieving Quality & Competitive Position.
- Gitlow, H.S. & Gitlow, S.J. (1987). The Deming guide to quality and competitive position. Englewood Cliffs NJ: Prentice-Hall.  
Written by a husband and wife statistician team who are Deming disciples, this book provides an "action manual" of questions and solutions for implementing the Deming philosophy. The Gitlows provide an in-depth discussion of the philosophy that is a valuable guide for both personal reflection and group discussion.
- Killian, C.S. (1988). The world of W. Edwards Deming. Washington D.C.: CEEPress Books.  
Written by Dr. Deming's personal secretary, this book provides insight into the man who may have had the most profound impact on business since Henry Ford.
- Mann, N. (1985). The keys to excellence. The story of the Deming philosophy. Los Angeles: Prestwick Books.  
Another biography of Dr. Deming. Nancy Mann provides a history of Dr. Deming with an emphasis on the events in his life that shaped his famous philosophy. Interesting but not vital to an understanding of Dr. Deming's philosophy.
- Neave, H.R. (1990). The Deming dimension. Knoxville, TN: SPC Press.  
Written by one of the first of Deming's British disciples, provides the best discussion to date of the basis of Dr. Deming's philosophy, Profound Knowledge, and how the famous 14 points grow out and point to that philosophy.
- Scherkenbach, W.W. (1988). The Deming route to quality and productivity. Washington D.C.: CEEPress.  
In-depth, point-by-point discussion of the Deming philosophy by the statistician that Deming installed at Ford Motor company to help them institute his philosophy in their successful effort to reverse their alarming slide in the late 70's. An excellent second book to read on this topic before attempting the master's own, heavier book.

Scherkenbach, W.W. (1991). Deming's road to continual improvement. Knoxville TN: SPC Press.

An update of his 1988 book with additional information on implementation and some of the statistical thinking of TQM.

Walton, M. (1986). The Deming management method. New York: Dodd, Mead & Company.

Excellent first book to read on the Deming philosophy. The "comic book" version, being the most readable, if not the most in-depth presentation of this complex topic.

Walton, M. (1990). Deming management at work. New York: G.P. Putnam's Sons.

An update of Mary Walton's 1986 book, provides examples and an extremely readable presentation of a complex topic. One of these two are an excellent first book on the Deming philosophy.

### The Teachings of Dr. J.M. Juran

Juran, J.M. & Gryna, F.M. (1989). Juran's quality control hand book. 4th ed. New York: McGraw-Hill.

An extensive guide to Quality Control practices and tools. Not necessary for Juran implementation, but of potential use in some organizations.

Juran, J.M. (1989). Juran on leadership for quality. An executive handbook. New York: Free Press.

The keystone book for Juran's philosophy, this is a must for any organization considering the use of the Juran model for TQM implementation. Fairly easy to read with many useful illustrations, it makes the majority of the Juran system understandable.

### Statistics

Brassard, M. (1988). The memory jogger. A pocket guide of tools for continuous improvement. Methuen, MA: GOAL/APC.

An excellent reminder book for use by improvement team members, facilitators and leaders. Contains "memory joggers" for the seven tools as well as idea-generating, team-building and consensus-seeking techniques. Closely follows the layout and training found in Ishikawa's Guide to Quality Control textbook, without as much detail.



Brassard, M. (1989). The memory jogger Plus+. Methuen, MA: GOAL/APC.

A good textbook for the seven quality planning tools (also called the seven new tools). This is a larger book and doesn't fit in a shirt pocket like The Memory Jogger. It contains examples and descriptions of the seven quality planning tools as well as the complete text of The Memory Jogger.

Gitlow, H.S., Gitlow, S.J., Oppenheim, A. & Oppenheim, R. Tools and methods for the improvement of quality. Homewood, IL: Irwin.

A good textbook for the seven QC tools and how they relate to TQM philosophy.

Ishikawa, K. (1982). Guide to quality control. Tokyo: Asian Productivity Organization.

Used as a textbook by both Japanese high school students and quality circle members, this is the best textbook for teaching the "seven tools" of statistical process control. Dr. Ishikawa won the Deming Prize for his invention of one of these tools, the cause and effect or fishbone diagram. This is an invaluable book for improvement team members, facilitators and leaders. These seven tools are all that are needed to address 95% of the problems in processes. Included are such tools as flowcharting, run charts, histograms and Pareto charts, and the control chart.

Mizuno, S. (Ed.) (1988). Managing for quality improvement, the seven new QC tools. Cambridge MA: Productivity Press.

Developed to solve the 5% of problems the seven tools could not solve, the seven new QC tools include several more powerful, and more complicated statistical methods to examine and plan processes. Included are the affinity diagram, interrelationship diagram, PERT and others.

#### TQM/MGEEM

Tuttle, T.C. & Weaver, C.N. (1986). Methodology for generating efficiency and effectiveness measures (MGEEM): A guide for commanders, managers, and supervisors (AFHRL-TP-86-26, AD A174 547). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Provides a commander's overview of the MGEEM process as it was developed in the early 80's. This guide has since been replaced with the companion special report to this one, Implementing TOM I: The Command Imperative.

Tuttle, T.C. & Weaver, C.N. (1986). Methodology for generating efficiency and effectiveness measures (MGEEM): A guide for Air Force measurement facilitators (AFHRL-TP-86-36, AD A174 547). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Companion to AFHRL-TP-86-26 above, this was the facilitator and technical guide to the MGEEM. This has since been replaced by the other special reports in this series, namely Implementing TQM II and Implementing TQM III.

Weaver, C.N. (1991). TQM: A step by step guide to implementation. Milwaukee, WI: ASQC Quality Press.

This book describes the crisis of quality in the United States and suggests that two mountains stand in the path to quality: all to common abuses of personnel and barriers that prevent personnel from doing their best work. Since both of these mountains were put in place or allowed to be put in place by senior leadership, it is only senior leadership that can remove them. This book recommends that senior leadership ensure integrity in all personnel actions and implement the management philosophy of Dr W. Edwards Deming. A structured technique for implementing Dr Deming's philosophy is presented through a management information system that provides improved leadership and a systematic means of soliciting employee inputs for continual improvement (TQM/MGEEM).

Weaver, C.N. & Looper, L.T. (1989). Methodology for generating efficiency and effectiveness measures (MGEEM): A guide for the development and aggregation of mission effectiveness charts (AFHRL-TP-89-7; AD A 208353). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Documents the ME Chart improvement to the MGEEM technology. Much of the relevant information in this guide has since been incorporated in TQM III.

Weaver, C.N., & Looper, L.T. (no date). MGEEM: New methods of measuring and enhancing organizational productivity. Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Five page executive summary of the TQM/MGEEM technology. Although lacking in detail, it provides the shortest overall summary of the TQM/MGEEM system.

#### MISCELLANEOUS

Barker, Joel A. (1985). Discovering the Future: The Business of Paradigms. St Paul, MN: I.L.I. Press.

Based on his film of the same name, this book discusses paradigms as they effect our lives and the way we do business. Understanding that TQM is a new leadership paradigm, this can

be a valuable resource toward understanding the difficulty in implementation and "doing TQM right."

Peters, Thomas J. & Waterman, Robert H., Jr. (1982). In Search of Excellence: Lessons from America's Best Run Companies. New York: Harper & Row.

The first of the Tom Peters books, it has sold over 7 million copies. Mainly a collection of anecdotal stories of "excellent" companies. Many reviewers (including Tom Peters) have had strongly negative comments about this book since its' release. It may not be as valuable as Tom Peters other book reviewed below.

Peters, T. (1987). Thriving on Chaos: Handbook for a Management Revolution. New York: Harper & Row.

Probably the best book by Tom Peters, it begins by saying, "There are no excellent companies." In it Peters preaches a new gospel more akin to Jeremiah than to the peaches and cream of his previous messages. In it are the most concrete guidelines for improvement Peters has ever offered.

Scholtes, P.R. (1990). The team handbook. Madison, WI: Joinere Associates, Inc.

The best book for the forming, chartering, running, and use of teams in a TQM organization. Every TQM agent should have access to this book.

### A Suggested Bookshelf

(Note: These suggestions reflect the personal bias of one of the authors of this report and does not necessarily reflect the wisdom or policy of any other person or organization.)

#### Essentials:

Out of the Crisis, Dr. W. Edwards Deming

The Memory Jogger, Michael Brassard

The Team Handbook, Peter R. Scholtes

#### Desired:

The Deming Guide to Achieving Quality and Competitive Position, Drs. Howard and Shelly Gitlow.

The Keys to Excellence, Dr. Nancy Mann.

The Deming Dimension, H.R. Neave.

The Deming Route to Quality and Productivity, William Scherkenbach.

The Deming Management Method, Mary Walton.

Juran on Leadership for Quality, Dr. Joseph M. Juran.

The Memory Jogger Plus+, Michael Brassard.

Guide to Quality Control, Karou Ishikawa.

TQM: A Step-by-Step Guide to Implementation. Dr. Charles N. Weaver.

Discovering the Future, Joel Barker.